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DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

VHF DIRECTION FINDER

FOREWORD

The equipment described in this specification is a remotely controlled VHF Direction Finder System designed to operate in the frequency range 118.000 to 139.975 MHz. This specification consists of four parts, as listed below. Each part contains sections 1 to 6 inclusive. With subparagraphs thereunder. When reference is made to this specification, part numbers, as well as section and paragraph numbers, must be stated.

VHF DIRECTION FINDER

PART I

GENERAL REQUIREMENTS

1. SCOPE

1.1 Scope. - The equipment described in this specification is a remote controlled VHF direction finder system with provision for selection of 720 operating frequencies in the range 118.000 to 135.975 MHz. It will utilize the quasidoppler principle, be equipped with a wide aperture antenna array and respond to ELT emissions. The bearing presentation will be a three-digit numeric display with one (1) degree increments. System accuracy in an obstruction free environment shall be ± 3 (peak) degrees.

1.2 Major design features. - Major design features of this equipment include:

(a) High reliability (a specified MTBF of 10,000 hours).

(b) Solid state circuitry with minimum parts count.

(c) Remote control capability using a 4-wire circuit (FAA local circuit or type 3002 voice-band width data channel without conditioning).

(d) Modular construction to facilitate rapid exchange of subassemblies for repair.

1.3 Design for production. - The equipment will utilize, to the fullest possible extent, techniques and components compatible with quantity production.

2. APPLICABLE DOCUMENTS

2.1 FAA documents. - The following documents of the issue in effect on the date of the invitation for bids or request for proposals form a part of this specification to the extent specified herein. Where a requirement is specified in the text that conflicts with a reference specification, the text shall take precedence.

2.1.1 FAA specifications. -

FAA-G-2100/1	Basic Requirements for all Equipment
FAA-G-2100/3	Requirements for Equipment Employing Semiconductor Devices
FAA-G-2100/4	Requirements for Equipment Employing Printed Wiring Techniques
FAA-G-2100/5	Requirements for Equipment Employing Micro-electronic Devices
FAA-D-2494/1	Preparation of Manuscript
FAA-D-2494/2	Preparation of Manuscript Copy and Reproducible Artwork
FAA-G-2300	Panel and Vertical Chassis, Rack
FAA-E-163	Rack, Cabinet and Open Frame Types
FAA-L-810	Obstruction Lighting

2.1.2 FAA standards. -

FAA-STD-001a	Color and Texture of Finishes for NAS Equipment
FAA-STD-012a	Paint Systems for Equipment

(Copies of this specification and other applicable specifications, standards and drawings may be obtained from: Federal Aviation Administration, Washington, D.C. 20591, ATTN: Contracting Officer. Requests should fully identify material desired, i.e., specification numbers, dates, amendment numbers, complete drawing numbers; also requests should identify the invitation for bid, request for proposal or contract involved or other use to be made of the requested material.)

2.2 Military documents. - In addition to those listed in FAA-G-2100/1, the following Military documents, of the issue in effect on the date of the invitation for bids or request for proposals, form a part of this specification to the extent specified herein.

2.2.1 MIL standards and specifications. -

MIL-E-17555	Electronic Electrical Equipment, Accessories and Repair Parts; Packaging and Packing of
MIL-STD-470	Maintainability Program Requirement
MIL-STD-471	Maintainability Demonstration

MIL-STD-781 Reliability Tests, Exponential Distribution

MIL-STD-785 Reliability Programs for Systems and Equipment Development and Production

MIL-STD-38510 Microcircuits, General Specification for

(Ordering information of military standards and specifications is contained in FAA-G-2100 Supplement.)

2.3 Other publications. - The following publications of the issue in effect on the date of the invitation for bids or request for proposals shall form a part of this specification. This specification shall take precedence in the event of conflict.

2.3.1 National Fire Protection Association publications. - The following publication forms a part of this publication and is applicable to the extent specified herein.

NFPA NO. 70 National Electrical Code

NFPA NO. 78 Lightning Protection Code

Information on obtaining copies of NFPA publications may be obtained from National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts 02110.

2.3.2 Electrical Industry Association publications. - The following publications form a part of this specification and are applicable to the extent specified herein.

RS-449 General Purpose 37-Position and 9-Position Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

RS-334-67 Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission

(EIA standards can be obtained from the Electronic Industries Association, 2001 Eye Street, N.W., Washington, D.C. 10006.)

2.3.3 ASTM standards. - ASTM standards can be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

2.3.4 Aluminum association. - Publications for various aluminum types and designations may be obtained from the Aluminum Association, 818 Connecticut Avenue, N.W., Washington, D.C. 10006.

3. REQUIREMENTS -

3.1 General requirements. - The contractor shall provide all necessary services and material to design, develop, fabricate, test and deliver the equipment as required by Parts I thru IV of this specification and the contract schedule. Unless specified to the contrary (in subsequent parts hereof) the requirements stated in this Part I shall apply to the overall equipment listed in paragraph 3.2, Part I, of this specification.

3.1.1 Continuous duty. - The equipment shall be capable of continuous unattended operation under the service conditions of 3.4.2 herein. Refer to 1-3.2.3 of FAA-G-2100/1.

3.2 Equipment to be furnished by the contractor. - Each equipment furnished by the contractor shall be complete in accordance with all specification requirements. The following items shall be included with each equipment:

ITEM	QUANTITY	REFERENCE
Antenna	1	Part II
Receiver and Bearing Process Unit	1	Part III
Bearing Display and Control Unit	1	Part IV
Mating Connectors	1 set	Part I
Special Tools and Test Equipment	1 set	Part I
Interconnecting Cables	1 set	Part I

The foregoing is a functional breakdown of the proposed system and is not to indicate a mandatory method of assembling the system.

3.3 Instruction books. - Instruction book manuscripts and reproducible copy shall be furnished in accordance with FAA-D-2494.

3.4 Definitions. -

3.4.1 Normal test conditions. - The normal test conditions shall be the nominal design values for ambient temperature and power sources specified in 1-3.2.21 of FAA-G-2100/1 as modified by the following: Applicable nominal design power source voltages shall be single-phase, AC, 120.

3.4.2 Service conditions. -

3.4.2.1 Environmental conditions. - The environment under service conditions shall be that of Environment II specified in 1-3.2.23 of FAA-G-2100/1, with the exception that the temperature limits shall be -40 degrees C to + 60 degrees C.

3.4.2.2 Input power conditions. - The AC power Source variations under service conditions shall be as required by 1-3.2.23 of FAA-G-2100/1, for standard 120 Volt, AC power.

NOTE: The Antenna Service Conditions are listed separately under paragraph 3.3 of Part II.

3.4.3 System accuracy. - The term "system accuracy" is defined as a measure of excellance of the overall systems in terms of error in an obstruction free environment.

3.4.3.1 Instrumental accuracy. - Instrumental accuracy is the accuracy of the overall system with no deterioration due to site influences or effects of reflected signals that might be introduced at other than ideal sites, i.e., a non-reflective environment.

3.4.2.2 Site accuracy. - This is defined as the sum of instrumental accuracy plus deterioration due to a reflective environment.

3.4.4 Error. - Is defined as the deviation of the indicated bearing from the actual bearing or direction of arrival of the signal. Further, for stating performance requirement limits in this specification, error is the amount of deviation either positive or negative from the actual bearing, i.e., $\pm X$ degrees.

3.4.5 Standard test voltage. - The term "standard test voltage" is defined as a rf carrier 30% amplitude modulated at 1,000 Hz.

3.5 Frequency range. - The equipment shall be required to operate over the range of 118.000 to 135.975 MHz.

3.6 Frequency channel selection. - Channel selection shall be by means of a numeric keypad input with a visual display on both the Bearing Display and Control Unit and the Receiver and Bearing Process Unit to verify selection of a frequency. The numeric keypad on the Bearing Process Unit is useful only during the local mode of operation. The numeric keypad on the Bearing Display and Control Unit is useful only during the remote mode of operation. The numeric keypad selects any of 10 preset channel frequencies by pressing a single numeric key and the enter key in sequence; and selects any frequency by pressing numeric keys in sequence and then pressing the enter key.

3.7 Grounding, bonding, and shielding requirements. - The equipment shall meet the requirements of FAA-G-2100/1, paragraph 1-3.5.9. The AC power supply grounding shall meet the requirements of the National Electrical Code and shall use a green insulated equipment grounding conductor contained within the same raceway, cable or cord or otherwise run with the circuit conductors.

3.8 Reliability. - A reliability program plan in accordance with paragraph 1-3.19 of FAA-G-2100/1 shall be submitted in the contractor's proposal for approval and updated after contract award. The following requirements shall be demonstrated in accordance with 1-4.3.6 of FAA-G-2100/1.

3.8.1 Use of standard parts. - The reliability program shall include a parts control effort to assure maximum utilization of standard parts. Standard parts are those defined in FAA-G-2100/1, paragraph 1-3.14.8.

3.8.2 Meantime between failures. - The Direction Finder system shall provide a specified meantime between failures (MTBF) of not less than 10,000 hours for an ambient temperature of 30 degrees C. (Refer to 4.9 herein.)

3.8.3 Reliability analysis. - The reliability analysis in accordance with 1-3.19 of FAA-G-2100/1, including the application and stresses of each part, shall be conducted for an ambient temperature of 30 degrees C and a power input voltage 120 V AC.

3.8.4 Correction of failures. - A closed loop failure reporting and corrective action system shall be implemented at the start of the contractor's preliminary tests (1-4.3.1 of FAA-G-2100/1) and continued until all tests have been completed and the equipment accepted.

3.9 Maintainability. - A maintainability program plan prepared in accordance with 1-3.20 of FAA-G-2100/1 shall be submitted in the contractor's proposal and updated after contract award. The following requirements shall be demonstrated in accordance with 1-4.3.6 of FAA-G-2100/1.

3.9.1 Corrective maintenance. - All printed circuit cards, modules, or other assemblies of the Direction Finder System shall be readily accessible for maintenance, to accelerate and facilitate the location of faults and the replacement of faulty components. The maximum time to locate and to repair or replace any failed part, or the affected printed circuit board, module or other assembly and to restore service shall not exceed 15 minutes for 90% of the failures. The time for repair of any such failed assembly after it has been replaced shall not exceed 180 minutes, including checkout and alignment. (Refer to 4.10 herein.)

3.9.2 Preventive maintenance. - The time required for preventive maintenance shall not exceed 15 minutes in any 168 hour period. Any procedure which exceeds this 15 minute limit shall be regarded as corrective maintenance procedure.

3.10 System accuracy. - System accuracy shall be within $\pm$ 3.0 peak degrees for all vertical angles, from the horizontal up to 60 degrees during normal operating conditions as defined in paragraph 3.4.3 of Part I of this specification. Overall accuracy of measurement shall be evaluated with the complete system operating.

3.10.1 Instrumental accuracy. - Instrumental accuracy shall be within ± 2.0 peak degree during normal operating conditions as defined in Paragraph 3.4.3.1 of Part I of this specification. Overall accuracy of measurement shall be evaluated with the complete system operating.

3.10.2 Site Accuracy. - Site accuracy shall be within ±6.0 peak degrees during normal operating conditions as defined in paragraph 3.4.3.2 of Part I of this specification. Overall accuracy of measurement shall be evaluated with the complete system operating.

3.11 System stability. - For any given 48 hour period, indicated bearing from a fixed target shall not vary over a range of more than ± 2 degrees.

3.12 Sensitivity. - A signal of 5 microvolts per meter at the antenna in a nonreflective environment with a signal duration of 1.0 second, shall give a positive bearing indication that deviates not more than ± 2 degrees from the bearing of the signal. This requirement shall be met for all frequencies in the 118.000 to 135.975 MHz band checked at intervals of every two megahertz.

3.12.1 Signal duration. - The system shall meet the accuracy requirements as specified in paragraph 3.10 for received signals from 50 to 100,000 microvolts per meter which have a signal duration of 0.25 seconds or longer.

3.13 Selectivity. - When the input signal is varied from the selected nominal channel frequency (resonance) throughout the specified receiver passband (± 10.0 KHz) the indicated bearing shall not vary more than ± 2 degrees from that at resonance until the bearing indication ceases for all further frequency variations from resonance. This requirement shall apply throughout the input signal range from 5 to 100,000 microvolts per meter at the antenna and over the frequency range of 118.000 to 135.975 MHz.

3.14 Multiple signal detection. - The Bearing Display Indicator shall display three dashes (---) when multiple signals at the selected frequency are received, the two strongest signals differ in level by 6.0 dB or less and the quality of the DF bearing measurement has an rms bearing error of more than four degrees. The display shall restore directly to true bearing indication when the stronger signal is greater than 6.0 dB above weaker signals.

3.15 Modulation effects. - Indicated bearings shall not deviate from an unmodulated signal bearing by more than ± 2 degrees when the signal is 100% amplitude modulated with a 1,000 hertz tone or a downward sweeping tone from 1,700 hertz to 300 hertz repeating every two to four seconds.

3.16 Signal response. - Performance requirements shall be met for all signal levels from 5 to 100,000 microvolts per meter at the antenna.

3.17 Emergency locator transmitter detection. - The equipment shall respond to emergency locator transmitter (ELT) emission on 121.5 MHz.

3.18 Solid state design. - The equipment shall be of solid state design in accordance with paragraphs 3.19 and 3.20 herein. Tubes shall not be used.

3.18.1 Printed wiring. - Printed wiring in accordance with FAA-G-2100/4, shall be used wherever such wiring is suitable and practicable. All printed wiring boards shall be of the plug-in card type and shall be mechanically coded and keyed in such a manner that only properly coded boards can be inserted. One printed wiring board extender of each type and size used in the equipment shall be furnished in a suitable storage space within the equipment.

3.19 Microelectronic devices. - Microelectronic devices, as defined by FAA-G-2100/5 shall be in accordance with the following:

(a) All devices shall be hermetically sealed; plastic encapsulation may be used provided temperature requirements can be met.

(b) Sockets may be used for mounting.

(c) For desired devices not covered, a specification or drawing shall be prepared by the contractor and submitted to the FAA for approval.

(d) Dual level "B" parts shall be used.

(e) Markings shall be as specified in MIL-STD-38510.

3.20 Semiconductor devices. - Semiconductor devices shall be in accordance with FAA-G-2100/3. Sockets may be used for mounting.

3.21 Circuit protection. - All semiconductors and other components and wiring subjected to operational limits or dielectric stresses shall be protected under each of the following conditions, before any wiring or circuit component (other than fuses) is damaged.

(a) Each variable component or tuning control of any type (one at a time) adjusted throughout its full range between stops.

(b) Short-circuit on each power-transformer secondary winding, including each section of tapped windings, one short-circuit at a time.

(c) Short-circuit on each power supply filter capacitor (each capacitor connected to the rectifier-output through not over 600 ohms of series resistance), one short circuit at a time.

(d) Lightning and transient protection shall be provided for all control lines, AC lines, audio lines or RF lines leaving or entering the equipment rack containing the equipment specified herein. The circuitry shall protect all components against a 1000 volt peak pulse, both positive and negative with a rise time of 10 microseconds and decay time exponential to half amplitude in 1 millisecond (10 X 1000 waveshape). Proof that the design protection device is satisfactory shall be required.

3.22 Derating of electronic parts and materials. - The derating of parts and material shall be in accordance with FAA-G-2100/1, paragraph 1-3.14.7.

3.23 Design tolerance (end-of-life) values. - In designing circuitry for long term performance, consideration shall be given to part parameter drift. The circuits shall be designed to perform their intended function accommodating this long term parameter drift.

3.24 Equipment layout. - It shall be possible to locate the antenna up to 2,000 feet from the Receiver and Bearing Process Unit using coaxial cable, type RG-333, or equal. (See Part II, 3.17.)

3.25 Type of construction. - All units which form a part of this specification shall contain its own power supply and all other component parts necessary for its internal mode of operation. The AC power supply shall be an AC line receptacle and six foot power cord and shall be in accordance with FAA-G-2100/1, paragraph 1-3.6.6. The internal construction of all units shall be modular, with maximum use of plug in modules. The equipment shall be in accordance with FAA-G-2100/1, unless otherwise specified herein. All equipment pull-out drawers shall be of a full suspension roller type with latching stops. Friction-slide construction is prohibited. Slides shall be of sufficient rigidity to prevent rollers from jumping their tracks.

3.25.1 Materiels. - The equipment chassis, front panels, pullout suspension mechanisms, internal shields, brackets, subassembly enclosures and all similar parts shall be aluminum alloy, except for specific components where other materials are required by this specification or other applicable documents. Front panels shall be finished in accordance with FAA-STD-001a and FAA-STD-012a.

3.25.2 Dust Covers. - In addition to shielding required to achieve the technical performance prescribed for the Direction Finder System, suitable full dust covers top and bottom shall be provided as a part of the enclosure.

3.26 Control circuits. - The control circuits shall be designed so that both local control and remote control functions can be accomplished on the front panel of the Receiver and Bearing Process Unit. See Part III. During local control operation, the Local Indicator on the Bearing Display and Control Unit and the Receiver and Bearing Process Unit shall be on.

3.26.1 Interunit signals. - The transmission of all signaling functions, including bearing data, receiver channel selection, received voice, two way voice intercom, and control of remoted panel indicator lights shall require only one four wire type 3002 voice-band width data channel (without conditioning) voice grade telephone circuit between the Receiver and Bearing Process Unit and Bearing Display and Control Unit. All transmissions of signaling functions (except voice) shall be accomplished with protected, binary coded, frequency shifted, phase locked tone signals with parity bit, automatic error checking, or equivalent in signaling reliability. Accuracy of data transmission shall not be degraded by changes in telephone circuit attenuation of up to ± 10 dB from normal. Alternately, a four wire FAA local circuit may be used with no deterioration in system accuracy.

3.26.2 Signal levels. - Transmission of all signaling function levels shall be individually adjustable from -20 DBm to 0 dBm. Receive sensitivity shall be adjustable over the range from -40 dBm to 0 dBm, with automatic gain adjustment of +6 dBm from preset levels within this range. Voice and tone signals shall be isolated from each other with filters providing at least 40 dB discrimination.

3.26.3 Tone frequency tolerance. - Tone frequency variation shall not exceed ±0.5% from nominal values over the specified service conditions (Part I, 3.4.2).

3.26.4 Interface characteristics and timing. - The receiver and bearing process unit and the bearing display and control unit connection with the four wire type 3002 voice-band width data channel (without conditioning) telephone circuit shall meet the requirements of EIA Standards, RS-449 and RS-334.

The update rate of information transfer to the bearing display and control unit shall be once/second while the return route shall be twice/second. (The update rate of information transfer to the bearing display and control unit is slower since the digital signals are allotted bandwidth within the voice band.)

3.27 Design report. - The contractor shall submit a preliminary design including an electronic device complement report to the contracting office for review and approval before proceeding with construction of the first article model. This preliminary design shall include the configuration of all chassis panels, circuitry, and the necessary drawings. The electronic device complement report shall include all semiconductor diodes, transistors and microelectronic devices to be used in the equipment with full operating data at -10 degrees C, at 25 degrees C, and at 60 degrees C.

3.28 Mating connectors. - Mating connector requirements are defined in paragraph 1-3.16.3.1 of FAA-G-2100/1. All connectors used on a given equipment unit shall be in accordance with paragraphs 1-3.16.3 thru 1-3.16.3.7 of FAA-G-2100/1.

3.29 Special tools and test equipment. - Special tools and test equipment shall consist of all tools and test equipment required for installation, testing and maintenance at the sites selected by the government which are not part of the normal facility complement. These items are required for kitproofing and shall include lamp puller, PC card extractor, PC card extender, BITE, etc. A suitable portion of the equipment instruction book shall be devoted to these items. Government-owned tools and test equipment are available onsite on an as-is and as-available basis.

3.29.1 Maintenance equipment. - Any items of maintenance equipment not presently included as normal facility complement is required and shall be provided.

3.29.2 Spare card slots. - Within each major unit with printed circuit plug-in assemblies (card)s, there shall be at least two spare card slots with connector for each style card used in that unit. Also, spare power supply capability shall be provided comparable to that required by a typical PC card in the same unit.

3.29.3 PC card extender. - With each major unit with printed circuit plug-in assemblies (cards), there shall be a PC card extender for each style card used in that unit which may be stored in the spare card slot (Refer to 3.9.1 and 3.29.2 herein). The construction of the PC card extender shall permit exposure of the electronics for servicing when the PC card extender is plugged into the unit and the PC card is plugged into the extender.

3.29.4 Test points and connectors. - Each unit shall contain test points and connectors in accordance with 1-3.18 of FAA-G-2100/1, appropriately labled and numbered, as necessary to provide for the examination of significant voltages, signal amplitudes, waveforms and timing characteristics and to provide for the connection of test equipment for adjustment and maintenance operations. The type of test points and connectors provided shall be compatible with the applications for which the test points and connectors are needed. All test points and connectors shall be accessible with adequate visibility and clearance from adjacent objects to permit safe and unjampered connection of cables and probes. Connection to test points and connectors utilized in either adjusting or testing the unit for proper performance shall not necessitate interrupting operational use of the unit. Test points on plug-in printed wiring boards shall be located on the outside edge of the board.

3.29.5 Built-in test equipment (BITE). - Built-in test circuits shall be provided in antenna system receiver and processor unit and bearing display and control unit to facilitate expedient diagnostics, checkout and fault isolation. The BITE shall provide the following capabilities:

(a) Monitoring normal operation with minimal operator disturbance.

(b) Signal monitoring between all major functional circuits.

(c) Built-in test signals and references allowing the antenna/receiver processor site, bearing display/control site, or the entire system to be checked out in a stand-alone or totally operational condition.

(d) At the antenna/receiver/processor site, convert the serial data bit-stream, before it enters the modem, into an analog test signal with an A-scope like format.

(e) At the bearing display/control site, generate a simulated auxiliary and test pattern data sequence, in a bit-serial format that can be injected into the bearing display/control site circuits just after the modem.

A quality oscilloscope and volt-ohm-meter (government provided), and contractor-provided devices will be used as monitoring devices. BITE shall be designed to facilitate their use.

3.30 Interconnecting cables. - Interconnecting cables in accordance with FAA-G-2100/1 shall be furnished to provide a fully operational DF system in accordance with this specification. The cables between the antenna system and the receiver and bearing process unit shall not be furnished. The cables between the receiver and bearing unit and the bearing display and control unit will be of sufficient length to allow maintenance on the system but will normally not be used for remote operation.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. - The contractor shall provide and maintain a quality control program in accordance with the quality assurance provisions specified in Section 1-4 of FAA-G-2100/1.

4.2 Line frequency. - The contractor shall perform testing at 60 Hz. In addition, he shall offer test data as evidence of performance for line frequencies of 57 Hz, and 63 Hz ($\pm$0.2 Hz).

4.3 Classification of test. - The tests listed in this section are designated regarding class per 1-4.3 of FAA-G-2100/1 as follows:

Design Qualification Tests	D
Type Tests	T
Production Tests	P

The contractor's preliminary tests (1-4.3.1, FAA-G-2100/1) shall include all of the tests listed herein. The FCC type acceptance procedures shall be as designated in 1-4.3.5 of FAA-G-2100/1.

4.4 Design qualification tests. - These tests shall be performed on one complete set of equipment, which may be the set selected for Type Test No. 1 in accordance with 1-4.3.3.1 of FAA-G-2100/1, or another set of equipment selected by the FAA representative (not necessarily the second set selected for type test). In addition to the tests specified in 1-4.3.2 of FAA-G-2100/1, the design qualification tests shall include the tests designated "D" in paragraphs 4.7 and 4.8 herein.

4.5 Type tests. - These tests shall be performed on not less than two complete sets of equipment (modifies 1-4.3.3.1 of FAA-G-2100/1). The specific type test to be performed shall include the tests designated "T" in paragraphs 4.7 and 4.8 herein.

4.6 Production tests. - The specific production tests to be performed shall include the tests designated "P" in paragraph 4.7 herein.

4.7 Test - normal test conditions. - The following tests shall be performed under normal test conditions (3.4.1). The applicable minimal AC power source voltage and the corresponding tap setting shall be 120 volts.

Class	Test	Paragraph of this Specification (Part I)
D,T,P	Frequency range	3.5, 3.12
D,T,P	Frequency channel selection	3.6
D,T,P	Grounding, bonding, and shielding	3.7
D	Reliability	3.8 thru 3.8.4
D	Maintainability	3.9, 3.9.1, 3.9.2
D,T,P	System accuracy	3.10, 4.7.1, 3.12.1
D,T,P	Instrumental accuracy	3.10.1
D,T	Site accuracy	3.10.2, 4.7.2
D,T,P	System stability	3.11
D,T,P	Sensitivity	3.12, 3.12.1
D,T,P	Selectivity	3.13
D,T,P	Multiple signal detection	3.14
D,T,P	Modulation effects	3.15
D,T,P	Signal response	3.16
D,T,P	Emergency locator transmitter	3.17
D,T	Solid state design	3.18, 3.18.1
D,T	Microelectric devices	3.19
D,T	Semiconductor devices	3.20
D,T,P	Circuit protection	3.21
D,T	Derating of electronic parts and materials	3.22
D	Design tolerance (end-of-life) values	3.22
D,T	Equipment layout	3.24, 3.10, 3.10.2, 4.7.1, 4.7.2
D,T,P	Type of construction	3.25, 3.25.1, 3.25.2

Class	Test	Paragraph of this Specification (Part I)
D,T,P	Control circuits	3.26 thru 3.26.4
D,T	Ventilation and cooling systems	FAA-G-2100/1, 1-3.9 thru 1-3.9.6
D,T	Component and material test	4.11, FAA-G-2100/1, 1-4.3.2 thru 1-4.3.2.2
D,T	Mating Connectors	3.28
D,T	Special tools and test equipment	3.29 thru 3.29.5
D,T	Interconnecting cables	3.30

4.7.1 System accuracy. - The DF antenna shall be located on a site approximating an ideal site with an obstruction-free area having a minimum radius of 450 feet from the DF antenna array. A target transmitter shall be used for a test signal. The transmitting antenna shall be located at 150 feet from the DF antenna array. The DF antenna shall be rotated through 360 degrees, with bearings read every 5 degrees from 0 to 355 degrees. The indicated bearing shall be compared to the physical bearing of the transmitting antenna as read on an azimuth scale attached and orientated (+0.1 degrees) to the DF antenna. The target transmitting equipment shall be adjusted for 50 microvolts (+ 5 microvolts) of signal at the receiver input. The above test shall be conducted on 10 frequencies equally distributed throughout the band 118-136 MHz. (Refer to 3.10 herein.)

4.7.2 Site accuracy. - The DF antenna shall be located on a site approximating an ideal site with an obstruction-free area having a minimum radius of 450 feet from the DF antenna array. Equipment for this test shall include an AM transmitter and two vertical transmitter antennas, with a means for adjusting the phase to one antenna and a means for adjusting the power feed to the other antenna. The transmitter antennas shall be placed at least 150 feet radially from the DF antenna. Relative field strength from one transmitter antenna shall be 0.2 that of the other transmitter antenna and the lower field strength shall be such as to give 50 microvolts +5 microvolts of signal at the receiver input. (Input signal levels shall be measured with transmitter antennas excited one at a time.) One transmitter antenna shall remain fixed while the other transmitter antenna shall be moved around the DF through 360 degrees in 5 degree increments until a maximum error is reached. The phase to one antenna shall be adjusted to give maximum error at each 5 degree increment. The DF antenna shall then be rotated through 360 degrees with bearings read every 5 degrees from 0 to 355 degrees. The indicated bearing shall be compared to the physical bearing of the transmitter antenna (with the strongest signal) as read on an azimuth scale attached and orientated (+0.1 degrees) to the DF antenna. The above test shall be conducted on 10 frequencies equally distributed throughout the band 118-136 MHz. (Refer to 3.10.2 herein.)

4.8 Tests - service conditions. - The tests listed in the following tabulation shall be performed with all power transformer taps set at 120 volts while subjecting the equipment to the test procedure described in 1-3.3.1, 1-3.3.1.1, and 1-4.12 of FAA-G-2100/1, and the service conditions as specified in 3.4.2 thru 3.4.2.2 herein.

Class	Test	Paragraph of this Specification (Part I)
D,T	Frequency range	3.5, 3.12
D,T	Frequency channel selection	3.6
D,T	Grounding, bonding, and shielding	3.7
D,T	System accuracy	3.10, 4.7.1
D,T	Instrumental accuracy	3.10.1
D,T	Site accuracy	3.10.1
D,T	System Stability	3.11
D,T	Sensitivity	3.12
D,T	Selectivity	3.13
D,T	Multiple signal detection	3.14
D,T	Modulation effects	3.15
D,T	Signal response	3.16
D,T	Emergency locator transmitter	3.17
D,T	Circuit protection	3.21
D,T	Equipment layout	3.24, 3.10, 3.10.2, 4.7.1, 4.7.2
D,T	Type of construction	3.25, 3.25.1, 3.25.2
D,T	Control Circuits	3.26 thru 3.26.4
D,T	Ventilation and cooling systems	FAA-G-2100/1, 1-3.9 thru 1-3.9.6
D,T	Component and material test	4.11, FAA-G-2100/1, 1.4.3.2 thru 1.4.3.2.2
D,T	Mating Connectors	3.28
D,T	Special tools and test equipment	3.29 thru 3.29.5
D,T	Interconnecting cables	3.30

4.9 Reliability demonstration. - A reliability qualification test shall be conducted in accordance with MIL-STD-781, Test Plan V to verify compliance with the requirements of 3.8 herein and 1-3.19 of FAA-G-2100/1, using at least two complete sets of equipment (at the beginning of test) as defined in 3.2 herein. Selection of equipment for the test shall be made by the FAA representative.

4.9.1 Reliability test procedure. - The equipment selected for the reliability qualification test shall be mounted in one Type I cabinet rack (furnished by the Government) with optional blower (FAA-E-163), with two sets of each equipment items installed in this rack. Rack doors shall be closed during the reliability test and all unused panel spaces filled with blank panels to simulate a field installation. The equipment and rack shall be placed in an environmental chamber or other enclosure, and operated and tested in accordance with the following procedure.

(a) Burn-In (or debugging) period; refer to 5.1.7 of MIL-STD-781.

(b) Production tests under normal conditions. Refer to paragraph 4.6 herein.

(c) Increase the ambient temperature within the test chamber to 50 degrees + 5 degrees C and relative humidity of 50% + 10%, corresponding to a within rack ambient temperature (surrounding the equipment chassis) of approximately 60 degrees C.

(d) Conduct Test Plan V MIL STD-781 under the following conditions: Maintain ambient temperature within the test chamber at 50 degrees + 5 degrees C and relative humidity of 50% + 10%, for duration of test. The objective shall be to maintain the temperature as near to 50 degrees C as practical.

AC input voltage cycling:

First 8 hours, 110% of nominal
Second 8 hours, 100% of nominal
Third 8 hours, 90% of nominal

Continue input voltage cycling in the same order for the duration of the test.

Duty Cycle: Consecutive signal input for a period of 5 minutes time duration, alternating the signal input condition between the two equipments within the cabinet rack. Signal input amplitude shall be varied from 10 microvolts to 10,000 microvolts while the channel frequency shall be spaced approximately equally across the 118-136 MHz band.

Daily measurements (each 24 hour period):
Repeat Production Tests per paragraph 4.6 herein for for each 8 hour duty cycle above and record measurements.

(e) At the conclusion of Test Plan V, stabilize equipment under normal test conditions and repeat all production tests. Refer to paragraph 4.6 herein.

4.9.2 Failure criteria. - Failure criteria is defined in MIL-STD-781. Analysis shall be made in accordance with MIL-STD-781 paragraph 5.11.2.1.

4.10 Maintainability demonstration. - A maintainability demonstration shall be performed to show compliance with the requirements of 3.9 through 3.9.2 herein and 1-3.20 of FAA-G-2100/1.

4.10.1 Demonstration plan. - The contractor shall prepare a maintainability demonstration plan for approval by the contracting officer in accordance with 4.2 of MIL-STD-471.

4.10.2 Maintenance task selection. - The contractor shall demonstrate compliance with the time limitations specified in 3.9.1 herein through the fault simulation method. This method shall be performed by introduction of faulty parts, deliberate misalignments, etc. Simulated faults shall be generated for each anticipated failure mode of each module. The general technique of task selection as discussed in Appendix A of MIL-STD-471 for corrective maintenance tasks only shall apply.

4.10.3 Sample size. - The contractor shall submit 150 sample corrective maintenance tasks from which the FAA representative will randomly select 30 of these tasks for the maintainability demonstration.

4.10.4 Maintenance task generation. - In accordance with 4.3.1.2 of MIL-STD-471.

4.10.5 Accept/reject criteria. - Upon completion of all maintenance tasks, an acceptance decision shall be made if the 90th percentile point of the resultant distribution of observed maintenance times is equal to or less than 15 minutes for restoration of service and 180 minutes for module repair.

4.10.6 Maintainability demonstration report. - In accordance with 4.8 of MIL-STD-471.

4.11 Component and material tests. - Tests to demonstrate the compliance of components and materials with their applicable specification requirements (1-4.3.2, 1-4.3.2.1 and 1-4.3.2.2 of FAA-G-2100/1) shall be made using a 10,000 microvolt input signal in the 118-136 MHz band.

4.12 Semiconductor junction temperatures. - The junction temperatures of semiconductors shall be determined in accordance with the published data and recommendations of the semiconductor device manufacturer.

4.13 Proposed test procedures and test data forms. - Comprehensive test procedures and test data forms which the contractor proposes for use in conducting the tests of this specification shall be prepared by the contractor. The test procedures shall be complete and adequate for tests, with data on associated test equipment types and major qualification characeteristics. The test procedures shall be submitted to the FAA contracting officer sufficiently in advance of the contractor's scheduled date for testing to allow the Government 30 days or more in which to review and evaluate. One copy will be returned to the contractor, either with a statement that the proposed methods and forms are approved by the Government for use by the contractor or with a statement pointing out deficiencies in the proposed methods and forms. The contractor shall not proceed with testing, using his proposed test methods, without approval of the Government. The approved test data forms shall be used to show all contract equipment test results.

4.13.1 Test data forms. - The contractor shall prepare test data forms for each equipment subjected to test. The data forms shall show the date, time, contract number, equipment name, unit identification or serial number and category of test conditions. Each test data entry shall include the applicable specification, paragraph number, and performance limits, stated therein and method of computation when used.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. - Preservation and packaging shall be in accordance with MIL-E-17555, level C.

5.2 Packing. - Packing shall be in accordance with MIL-E-17555, level B.

6. NOTES

6.1 Note on information items. - The contents of this Section 6 are only for the information of the initiator of the procurement request and are not a part of the requirements of this specification. They are not contract requirements nor binding on either the Government or the contractor. In order for these terms to become a part of the resulting contract, they must be specifically incorporated in the schedule of the contract. Any reliance placed by the contractor on the information in these subparagraphs is wholly at the contractor's own risk.

6.2 Design report approval.- The contract schedule should contain requirements that the contractor submit a preliminary design report to the contracting officer for approval before proceeding with construction of the first article model equipments. Such approval should be based on Government determination of compliance with the specification. The contract schedule should require an allowance of approximately two weeks after receipt by the contracting officer of each submission, before approval, comments, or request for resubmission will be mailed to the contractor by the contracting officer.

6.3 Progress reports. - The contract should require monthly progress reports beginning the first calendar month after the effective date of the contract.

PART II

ANTENNA SYSTEM

1. SCOPE

1.1 Scope. - The equipment specified in this part consists of the VHF Antenna system.

2. APPLICABLE SPECIFICATIONS AND DRAWINGS

2.1 See Section 2, Part I hereof. -

3. REQUIREMENTS

3.1 See Section 3, Part I hereof.

3.2 General. - The antenna system shall consist of a wide-aperature, vertical dipole array covering the 118-136 MHz (VHF) band, with electronically switch elements.

3.3 Service conditions (antenna system). - The antenna system shall meet all specification requirements under the service conditions of Environment III of 1-3.2.23 of FAA-G-2100/1, with a gust factor of 1.3 applied to the wind conditions of 0 to 100 m.p.h.

3.3.1 Structural design. - Compliance with the service conditions from a structural standpoint shall be based on tests conducted on a production prototype of the antenna system with distributed mechanical loading equivalent to the specified wind velocity and ice loading. The contractor shall submit his full structural design calculations, including descriptions and analysis of the proposed structural tests, for review by the Government. The contractor shall not proceed with production until he has received Government approval. This approval does not release the contractor from meeting all contract requirements and specifications at the time of final inspection. A period not to exceed 30 calendar days shall be allowed the Government for review and approval. Structural design calculations shall include all elements, loads and reactions, maximum deflections at design and at one-half design load. The structural design of the antenna system shall specifically include the effect of ambient temperature on allowable mechanical stress.

Compliance with the service conditions in paragraph 3.4.2 of Part I and paragraph 3.3 of Part II from the standpoint of all factors be based on tests which inlude the completely assembled antenna.

3.4 Normal conditions. - The existing outside temperature and humidity at the time of testing shall be considered normal conditions.

3.5 Construction. - The VHF array shall be mounted on a single vertical tubular support designed to position the antenna array at a height of 9 feet above the ground, flat top roof, or steel self-supporting tower. The tubular support shall have a mounting flange and shall be mounted by bolts for attachment in the field to the supporting tower or other structures furnished by the Government. No guy wires shall be required. Provision shall be made for steps and safety climbing device on the antenna support.

The entire support for each individual dipole shall be arranged for easy field removal and replacement with not more than four machine screws or a threaded locking ring. Electrical connections shall be plug-in with the mating connectors attached to the associated mechanical elements such that electrical connection will be made concurrently with the attachment of the dipole and its support to the array. Separate mechanical alignment pins, or equivalent, shall insure correct positioning. All dipoles shall be mechanically and electrically interchangeable.

3.6 Counterpoise. - The antenna system shall not require the use of a counterpoise to meet the system accuracy requirements.

3.7 Element spacing. - The maximum phase step between adjacent antennas about the periphery of the antenna array shall be 140 electrical degrees for the highest frequency in the VHF band.

3.8 Switching. - The ratio of signal level in an "off" antenna shall be at least 30 dB down relative to that from an "on" antenna.

3.8.1 Insertion loss. - The insertion loss of any switching device shall not exceed 4 dB.

3.9 Accessibility. - The antenna system shall be so arranged and equipped as to provide easy access to all components without the use of auxiliary access equipment and without bending any cables. This shall include access to the top mounted obstruction light, dipoles on the VHF array, switching units and cables. Access shall be provided from the base of the antenna system and its support as provided by the manufacturer.

3.10 Structural materials. - Structural elements of the antenna system shall be either of the following materials:

3.10.1 Steel. - ASTM-A242 similar and equal to U.S. Steel COR-TEN or Bethlehem Steel Mayari R having corrosion resistance at least two times greater than structural carbon steels. The steel shall have a minimum yield point of 42 KSI.

3.10.2 Aluminum alloy. - Structural type, 6061-T6, 6062-T6 or equal. For castings, 222.0-T61 (Aluminum Association Designation).

3.11 Dissimilar metals. - Dissimilar metals shall be in accordance with FAA-G-2100/1 paragraph 1-3.16.24.

3.12 Finishes. - Except as specified in this section, the finishes of all antenna system components shall meet the requirements of FAA-G-2100/1 paragraph 1-3.8.

3.12.1 Steel components. - All steel (other than stainless steel) components shall be galvanized in accordance with ASTM-A123 and A385 after all machining and welding operations have been completed and before any other finish is applied. Galvanized surfaces shall be properly neutralized prior to further finishing.

3.12.2 Aluminum components. - Aluminum alloy shall have a protective anodic coating of 0.2 MIL minimum equal to Finish A212 (Aluminum Association Designation).

3.12.3 Metal surfaces. - All external metal surfaces of the antenna system shall be given at least one uniform spray coat of primer, baked on, followed by two uniform spray coats of smooth International Orange enamel, baked on. Surfaces shall be free of oil, grease, rust, corrosion or other foreign matter before the finish is applied. The finished shall not crack, chip or peel under service conditions.

3.12.4 Hardware. - Hardware, including screws, requiring removal for servicing the antenna system shall be either stainless steel or bright nickel plated brass. Nickel plating on hardware shall not chip, flake or deteriorate under service conditions.

3.13 Obstruction lighting. - A standard dual obstruction light fixture in accordance with specification FAA-L-810 shall be provided on the top of the antenna array. Provision shall allow removal of fixture and capping of the antenna fitting on the antenna. Provision shall be made for maintenance of the obstruction light.

3.14 Provision for external connections. - The antenna system shall be completely wired internally with all connections to external circuits terminated in connectors in accordance with FAA-G-2100/1 paragraph 1-3.16.3 and be equipped with mating cable plugs. These connectors shall be located within a weatherproof enclosure at the level of the lowest point of attachment of antenna elements to the tubular support. Provision shall be made for entrance and support of external cables (with plugs attached) to the antenna connectors through the full length of the tubular support below the weatherproof enclosure. Separate connectors shall be provided for each RF cable and for the obstruction light cable. The external cables for use between the antenna system and the receiver are not to be furnished by the contractor except for conducting acceptance tests at the contractor's plant.

3.15 Weatherproofing. - The entire structure (except for the bottom of the main support tube) shall be completely weatherproof. Provisions shall be made to minimize moisture and condensation within the antenna including the use of air circulation vents and moisture drain holes. A means of inspection for moisture accumulation shall be provided.

3.16 Protection against atmospheric electricity and lightning. - Each antenna system shall be protected against atmospheric electricity and lightning. The minimum protection for each antenna system shall afford all external elements with a protective path to ground and the minimization of the effects of arcing. Protection shall include air terminals, down conductors, ground rods, connectors, etc., all furnished and installed to meet the requirements of NFPA No. 78, Lightning Protection Code.

3.17 Preamplifier. - An antenna signal preamplifier shall be provided with the antenna assembly with its associated gain control located on the receiver and bearing process unit (See paragraph 3.36, Part III). It shall have a gain of 0 to 20 dB. Provisions shall be made for inspection and maintenance.

3.18 Antenna coverage pattern. - An antenna coverage pattern shall be provided. A profile pattern and an overhead pattern shall be provided, accompanied by range and altitude data. See Part I, paragraph 3.10, System Accuracy, and Paragraph 3.12, Sensitivity.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. - See Section 4.1 of Part 1, hereof.

4.2 Line frequency. - See Section 4.2 of Part I, hereof.

4.3 Classification of tests. - See Section 4.3 of Part I, hereof.

4.4 Design qualification tests. - See Section 4.4 of Part I, hereof.

4.5 Type tests. - See Section 4.5 of Part I, hereof.

4.6 Production tests. - See Section 4.6 of Part I, hereof.

4.7 Tests, normal conditions. - The following tests shall be performed under normal test conditions (3.4). The applicable minimal AC power source voltage and the corresponding tap setting shall be 120 volts. Other tests are included with Direction Finder System tests contained in Part I, hereof.

Class	Test	Parapgraph of this Specification (Part II)
D	Construction	3.5
D	Counterpoise	3.6
D,T,P	Element spacing	3.7
D,T,P	Switching	3.8
D,T,P	Insertion loss	3.8.1
D	Accessibility	3.9
D	Structural materials	3.10, 3.10.1, 3.10.2
D	Dissimilar metals	3.11
D,T,P	Finishes	3.12 thru 3.12.4
D	Obstruction lighting	3.13
D,T,P	Provision for external connections	3.14
D,T	Weatherproofing	3.15
D,T	Protection against atmospheric electricity and lighting	3.16
D,T,P	Preamplifier	3.17
D	Antenna coverage pattern	3.18

4.8 Tests - service conditions. - The tests listed in the following tabulation shall be performed with all power transformer taps set at 120 volts while subjecting the equipment to the test procedures described in 1-3.3.1, 1-3.3.1.1, 1-3.2.2.3, and 1.4.12 of FAA-G-2100/1 and the service conditions as specified in 3.3 herein.

Class	Test	Paragraph of this Specification (Part II)
D	Construction	3.5
D	Counterpoise	3.6
D, T	Element spacing	3.7
D,T	Switching	3.8
D,T	Insertion loss	3.8.1
D	Accessibility	3.9
D	Structural materials	3.10, 3.10.1, 3.10.2
D	Dissimilar metals	3.11
D,T	Finishes	3.12 thru 3.12.4
D	Obstruction lighting	3.13
D,T	Provision for external connections	3.14
D,T	Weatherproofing	3.15
D,T	Protection	3.16
D,T	Preamplifier	3.17
D	Antenna coverage pattern	3.18

5.1 See Section 5 of Part I, hereof.

6. NOTES -

6.1 See Section 6 of Part I, hereof.

PART III

RECEIVER AND BEARING PROCESS UNIT

1. SCOPE

1.1 Scope. - The equipment specified in this part consists of the VHF receiver, the bearing process unit, provisions for remoting test signals, and appropriate interface to a four wire voice grade circuit. (FAA local circuit or type 3002 voice-band width data channel without conditioning.)

2. APPLICABLE SPECIFICATIONS AND DRAWINGS

2.1 - See Section 2, Part I, hereof.

3. REQUIREMENTS

3.1 - See Section 3, Part I, hereof.

3.2 Packaging and construction

3.2.1 Equipment mounting. - The VHF receiving equipment, bearing process unit, and associated power supplies shall be designed to mount in a Type I, II and III cabinet type rack in accordance with specification FAA-E-163. The rack is not to be furnished by the contractor of this equipment.

3.2.2 Chassis. - Chassis must be capable of mounting in a standard 19 inch rack. The chassis shall be equipped with full suspension roller bearing pullout drawer mechanisms with two front panel handles allowing the unit to be pulled forward and rotated to the +45, +90 and +135 degree positions for maximum access for servicing. Latching stops shall be provided for all positions. Installation of the equipment and suspension mechanism shall not require modification of the cabinet rack. Means shall be provided to protect and guide the equipment cable connections so that the equipment units may be freely adjusted to all positions allowed by the suspension mechanism without any interference between the cables and other equipment mounted immediately above and below in the cabinet rack.

3.3 VHF receiving equipment. -

3.3.1 Receiver. - The receiver shall be a superhetrodyne type. The frequency coverage shall be 118.000 to 135.975 MHz. Frequency selection shall be by means of a frequency synthesizer where 720 channels at 25 KHz spacing can be selected. Only one frequency shall be selected at any one time.

3.3.1.1 Frequency conversion. - Each intermediate and mixer frequency shall be chosen by the manufacturer, subject particularly to the limitations of undesired frequency responses, operational stability and all other requirements of this specification.

3.3.1.2 Tuning. - Each tuning control shall be adjustable to the resonant frequencies by the null or peaking method without the use of stagger-tune, trial and error methods, etc. Continuous tuning adjustment shall be provided without changing coils, taps, links, etc. The requirement does not preclude pretuned elements.

3.3.1.3 Leakage. - All input and output circuits which are isolated from chassis shall present a leakage path to chassis not lower than 1.0 megohm.

3.4 Antenna input circuit. - The RF input circuit shall be designed for connection to a 50 ohm unbalanced flexible coaxial cable through a constant independance N-type connector at the rear of the equipment. The contractor shall furnish the mating type UG-21E/U plug. (See paragraph 3.2.8, Part I.)

3.4.1 Artificial antenna. - For all requirements involving the introduction of specified voltages to the RF input circuit of the receiver, a 50 ohm series resistor or a 50 ohm 6-dB resistive pad shall be interposed between the specified signal level source and the receiver.

3.4.2 Protective devices on input circuits. - The receiver shall contain suitable protective devices to isolate the input stages of the receiver from destructive transients originated by precipitation and lightning static or other external transient sources. The receiver shall withstand without damage or permanent impairment of sensitivity or gain at 118 and 136 MHz a channel input voltage of 20.0 Volts unmodulated applied to the RF input circuit continuously for a period of five minutes. (See paragraph 3.22, Part I.)

3.5 Frequency synthesizer. - A frequency synthesizer shall be provided to generate the oscillator frequencies for operation of the system on 720 frequencies starting at 118.000 MHz at each 25 KHz interval above that frequency up to and including 135.975 MHz. Interlock circuitry shall be provided to inhibit synthesizer operation unless the circuits are "locked up" (synchronized) on the selected frequency. A front panel indication shall be provided to indicate if the circuits are synchronized. Synthesizer synchronizing time shall not exceed 500 milliseconds. This indication shall also be transmitted to the Bearing Display and Control Unit to confirm frequency selection within 2.0 seconds.

3.5.1 Frequency adjustment. - A control for adjustment of the oscillator frequency shall be provided. Under normal test conditions (Part I, 3.4.1) the range of adjustment shall be not less than +10 parts per million from the specified frequencies. This control shall be accessible without removal of the synthesizer module, but not necessarily at the front panel of the receiver.

3.5.2 Crystal units. - The requirements of FAA-G-2100/1, Paragraph 1-3.16.17 shall apply. The specific crystal types are not specified, but no more than one crystal shall be used in the synthesizer.

3.5.3 Synthesizer preset. - Provisions shall be for manual configuration of 10 preset frequency channels within the frequency coverage as defined in paragraph 3.3.1 of Part III herein. Each of 10 preset controls may be configured to any frequency designation. The numeric keypad shall provide the enabling signal function to select any one of the 10 preset frequency channels.

3.5.4 Starting. - The crystal oscillator stages shall start oscillation within one minute with application of power and will operate reliably over service conditions.

3.5.5 (NOT USED).

3.5.6 Long term frequency drift. - Long term drift of frequency shall not exceed one (1) part per million per year.

3.5.7 Crystal oven. - A semiconductor proportionally-controller crystal oven shall be provided in accordance with the following if an oven is needed to meet the frequency stability requirements.

Operating temperature	Controlled 75 degrees $\pm$ C
Heater power	25 Watts or less
Heater power, after warm-up	10 Watts or less

Electro-mechanical thermostatic switch and relay operated ovens shall not be used.

3.5.8 Frequency synthesizer timing. - The operational time of the frequency synthesizer shall be a maximum of 500 milliseconds. The frequency lockup time (time when the frequency selection is made until confirmation is received) shall be less than 2.0 seconds.

3.6 Frequency accuracy and stability. - Utilizing the standard tuning procedures prescribed in the instruction book, the receiver shall be tuned without benefit of the frequency counter and shall operate within +0.002% of the specified channel frequency. Accuracy and stability shall be maintained over the environmental range. A calibrated frequency counter shall be used to verify the accuracy after the tuning operation has been completed.

3.6.1 Maximum allowable frequency deviation. - Under all combinations of service conditions specified including those combinations where the net effects are additive, the total deviation under humidity, temperature, and power fluctuations shall not exceed $\pm$.002% of the designated operating frequency.

3.6.2 Effect of detuning and retuning. - The receiver shall be detuned to the limit of the tuning controls from the operating frequencies and then retuned to the specified channels using the standard tuning procedures. Each frequency shall be within the previously specified accuracy of a ±0.002% of the operating frequency without benefit of any external frequency measuring device during the tuning process.

3.7 Local oscillator coupled output. - All frequencies generated by the local oscillator including all primary frequencies, harmonics, mixer products and identifiable products thereof and all other spurious outputs shall not exceed a level of 20 microvolts measured at the antenna terminal of the receiver when terminated into a 50 ohm load.

3.8 Oscillator interaction. - Sufficient isolation and shielding shall be incorporated to insure that all output due heterodyning of local oscillator frequencies or any combinations of the harmonics from the oscillators, both with and without an incoming signal, are down 10 dB or more, referred to the output produced by a standard test voltage of 5 microvolts, and to insure that the squelch does not open due to such heterodyning.

3.9 Operational stability. - The receiver shall be free of all traces of heterodyning of RF and/or AF regeneration which may appear in such forms as either audible or inaudible.

3.10 Receiver sensitivity. - The receiver shall be designed to produce audio output in a 600 ohm load with a 10 dB (minimum) signal plus noise to noise ratio at the speaker output terminals, when a standard VHF radio frequency test voltage of 5.0 microvolts (30% modulated at 1 KHz) is applied to the receiver input.

3.11 RF gain control and characteristic. - RF gain control shall be provided. The RF sensitivity, with the RF gain control set at mid-scale, shall be between 10 and 30 microvolts standard test voltage and at a minimum RF gain shall be 50 microvolts or higher standard test voltage.

3.12 Selectivity. - The bandwidth of the intermediate frequency amplifier shall conform to the following profile with respect to the center frequency and shall not have any extraneous deviations throughout the bandwidth of ± 25 KHz.

Attenuation	Bandwidth
6 dB	± 10 KHz minimum
60 dB	± 18 KHz maximum

3.12.1 Pass band characteristics. - Any decreases in the pass band envelope (± 6 KHz) shall not exceed 1 dB below the peaks of the envelope.

3.13 Undesired RF responses. - The ratio of standard test voltage necessary at all undesired response frequencies including image and IF, to the standard test voltage at the channel frequency to which the receiver is tuned shall be not less than 60 dB outside the 60 dB selectivity bandwidth (3.12) but, within ± 0.9 MHz from the channel frequency; also, the ratio shall be not less than 60dB for all undesired responses beyond ± 0.9 MHz limits including IF and images.

3.13.1 (NOT USED).

3.13.2 Blanking filter. - A blanking filter shall be provided to limit the effect of high level off channel signals. With a standard test signal of 5 microvolts applied to the receiver input, a signal 55 dB greater and removed 250 KHz from the test signal shall not affect the bearing indication by more than three degrees.

3.13.3 Commutation noise filter. - A filter (if required) shall be provided to decrease the commutation noise in the receiver output by not less than 10 dB.

3.14 (NOT USED).

3.15 (NOT USED).

3.16 (NOT USED).

3.17 (NOT USED).

3.17.1 (NOT USED).

3.18 Squelch. - The receiver shall be provided with a carrier operated squelch circuit with the threshold adjustable from 50 microvolts to 0.5 microvolts (or less). The squelch operation may be controlled locally during local operation or remotely during remote operation.

3.18.1 Muting. - The noise level at the oputput of the receiver shall be no greater than -40 dBM when the squelch is on and adjusted for a threshold of 5 microvolts.

3.18.2 Squelch switch. - A two position toggle switch shall be provided to control the squelch operation during local control operation. The functions performed by the switch shall be "squelch on" and "squelch off."

3.18.3 Bearing. - A bearing shall not be indicated because of noise until a carrier signal reaches at least that input level to break the squelch.

3.19 (NOT USED).

3.20 (NOT USED).

3.21 (NOT USED).

3.22 Audio outputs. - There shall be two separately controlled audio outputs provided. The two audio outputs shall be isolated such that there shall be no interaction between the two outputs when either or both audio output(s) level control(s) is (are) adjusted.

3.22.1 Headset output. - A standard headset jack shall be front panel mounted to provide capability to monitor an audio output. A front panel control shall be provided to adjust the output level from -30 dBM to +10 dBM into a 600 ohm load.

3.22.2 Interunit output. - An audio output shall be combined with bearing and control signaling functions and transmitted to the bearing display and control unit. Level control and further processing of the audio shall be in compliance with the interunit signals and signal levels description contained in paragraphs 3.26.1 and 3.26.2 of Part I herein.

3.23 Two way voice intercom. - Provision shall be made for rear panel connection of an external two way voice intercom unit. The intercom unit is not to be furnished as part of this specification. The intercom will be used for interfacility voice communication between the antenna/ receiver and bearing process unit site and the bearing display and control unit site. Provision shall be made for simultaneous transmission of two way voice communication and all other interunit signals in accordance with paragraph 3.26.1 of Part I.

3.24 (NOT USED).

3.25 (NOT USED).

3.26 (NOT USED)

3.27 Protective devices on audio circuits. - All audio circuits shall withstand, without permanent damage, input pulses applied to each output terminal pair and from terminals to chassis of +1,000 volts peak, with rise time not over 10 microseconds, duration of not over 50 microseconds, and decay time of not less than 600 microseconds measured between 10% and 90% of peak amplitude. After 100 pulses of each polarity applied between output terminals and afterwards between terminals and chassis at intervals of not over 1 second, any resulting change in gain of the output stage shall not exceed 0.2 dB.

3.28 Covers. - The unit shall be fully enclosed with easily removable metal dust covers. The covers shall be constructed of sheet metal and be provided with a minimum number of openings to permit adequate ventilation with the equipment operating.

3.28.1 Accessibility. - The major components of the receiver and bearing processor unit and all necessary test points and adjustment or alignment controls other than those on the front panel shall become readily available with the covers removed.

3.29 Handles. - Two handles shall be provided and located on the front panel for handling the unit during insertion and removal from its mounting place.

3.30 Test points. - Test points necessary to confirm proper operation of the receiver and bearing processor unit and necessary in the location of faults in major modules shall be available. Test points to be chosen by the vendor with Government approval required. Test points shall be readily identified and cross-referenced in the instruction book which also shall contain reference to necessary waveforms, voltage, current, or resistance readings that may be appropriate for the individual test points.

3.30.1 Test point remoting capability. - All test points shall be wired to a connector located on the rear of the equipment. The connector shall provide the capability for remote equipment monitoring to accommodate future automation.

3.31 Power sources. - The receiver shall operate from power sources specified in paragraph 3.4.1, Part I of this specification.

3.31.1 Power supply. - The power supply shall be designed as an integral part of the unit with adequate measures taken to insure against the generation of the RF or AF interference that would be objectionable in communication receivers located adjacently. An AC power cord shall be provided in accordance with paragraph 3.25 of Part I.

3.32 Indicator lights. - Indicator lights and their associated assemblies shall be in accordance with FAA-G-2100/1, paragraph 1-3.16.5.

3.33 Special tools. - The contractor shall supply, with each receiver and bearing processor unit any special tools which shall be mounted in suitable clips on the chassis.

3.34 Front and rear panel controls and indicators.

3.34.1 Front panel specification. - Channel selection, control, and bearing display shall be located on the front panel of a horizontally rack-mounted chassis. Front panel controls and indicators shall consist of the following:

Control or Indicator	Description	Function
Power On/Off control	Two-position toggle	When set to ON, power is applied to the unit; when set to OFF, unit is inoperable and consumes no power.
Power ON/OFF Indicator	Lamp, green	Illuminates when the power switch is turned ON.

Control or Indicator	Description	Function
Fuse	Fuseholder	Active AC line fuse
Spare	Fuseholder	Spare AC line fuse
Remote/Local Control	Two-position toggle	When set to LOCAL, the DF control is at the Receiver and Bearing Process Unit front panel. When set to REMOTE, the DF is controlled by the Bearing Display and Control Unit.
Local Indicator	Lamp, white	When illuminated, indicate DF system is in Receiver and Bearing Process Unit LOCAL control.
System Alarm	Lamp, red	When illuminated, indicate failure mode including parity error, control line failure, and interunit failure.
Receiver-Frequency MHz Display	Six-Digit Display	Displays the frequency that is selected. Activates only after synthesizer is locked up. (See 3.5.8 of Part III.)
Frequency MHz Select	Numeric keypad	Selects any of 10 preset channel frequencies by pressing a single numeric key and the enter key in sequence. Selects any frequency by pressing numeric keys in sequence and then pressing the enter key. Selection is enabled during local control only.
Bearing Clear Switch	Momentary pushbutton	Clears the bearing display until another bearing is processed and displayed; during local control.
Bearing Display	Three-digit display surrounded with electronic compass rose.	Displays the processed bearing angle in degrees from 000^{o} to 359^{o} in one degree increments.

Control or Indicator	Description	Function
QDM or QDR Select	Two-position toggle	When set to QDM, the displayed bearing angle is referenced from the source (aircraft) to the DF antenna; when set to QDR the displayed bearing angle is referenced from the DF antenna to the source; during local control.
QDR Indicator	Lamp, amber	Illuminates when bearing reference is QDR.
Squelch ON/OFF Control Switch	Two-position toggle	When set to ON the receiver squelch operate normally; when set to OFF, the squelch is disabled; during local control.
Squelch Indicator	Lamp, blue	Illuminates when the receiver audio is enabled (not squelched).
Squelch Level Control	Recessed Potentiometer	Adjusts the squelch threshold sensitivity.
Preamplifier Gain Control	Recessed Potentiometer	Adjusts the preamplifier gain (in the antenna).
Headset output	Headset jack	Provides an audio output (see 3.22.1, Part III).
Headset Output Level Control	Potentiometer	Adjust audio level at the headset output (see 3.22.2, Part III).
Dimmer control	Potentiometer	Controls the brightness of all light emitting devices on the front panel.
System Test Control	Momentary Pushbutton	Initiates a self-test routine that checks power supplies and verifies receiver - processor operations; during local control.
Lamp Test	Momentary Pushbutton	Illuminates all lamps to verify operation.

Control or Indicator	Description	Function
Fault Meter Control	Meter and Rotary Switch	Provides indications of power supply voltages and key performance parameters.
Overhead Pass Indicator	Lamp, yellow	Illuminates when aircraft passing over the DF antenna transmits on the selected frequency and the DF is unable to display a useable bearing.

3.34.2 Rear panel specification. - The AC Power Plug, Equipment Interconnection Plug, RF Antenna Plug, Antenna Interconnection Plug, Two Way Voice Intercom Plug and Remote Monitoring Plug shall be located on the rear of the Receiver and Bearing Process Unit. (See Part I, paragraph 3.28.)

3.35 Bearing process unit.

3.35.1 Design requirements. - This unit may be an integral part of the receiver, or may be provided separately for rack mounting.

3.35.2 Function. - Bearing information shall be extracted from the receiver IF signal and converted into digital signals for transmission to the Bearing Display and Control Unit.

3.35.3 Multiple signal capability. - The bearing display indicator shall display three dashes (---) during periods of multiple signal reception by the receiver and bearing process unit in accordance with paragraph 3.14, Part I. Voice shall continue when multiple signals are detected.

3.35.4 Bearing display. - The bearing display indicator shall be a lighted three digit numeric display large enough to be read with ease from a distance of six feet. The three digit display shall be surrounded by an electronic compass rose (a ring of LEDs). The indicator shall display the processed bearing angle in degrees from 000^{o} to 359^{o} in one degree increments. Each LED shall illuminate individually to represent the relative azimuth of the bearing indicated on the three digit numeric display.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. - See Section 4.1 of Part I, hereof.

4.2 Line frequency. - See Section 4.1 of Part I, hereof.

4.3 Classification of tests. - See Section 4.3 of Part I, hereof.

4.4 Design qualification test. - See Section 4.4 of Part I, hereof.

4.5 Type tests. - See Section 4.5 of Part I, hereof.

4.6 Production tests. - See Section 4.6 of Part I, hereof.

4.7 Tests - normal test conditions. - The following tests shall be performed under normal test conditions (See 3.4.1, Part I hereof). The applicable nominal AC power source voltage and the corresponding tap setting shall be 120 volts.

Class	Test	Paragraph of this Specification (Part III)
D,T	Equipment mounting	3.2.1
D,T	Chassis	3.2.2
D,T,P	Receiver	3.3.1
D	Frequency conversion	3.3.1.1
D,T,P	Tuning	3.3.1.2
D,T	Leakage	3.3.1.3
D,T	Antenna input circuit	3.4
D	Artificial antenna	3.4.1
D,T	Protective devices	3.4.2
D,T,P	Frequency synthesizer	3.5
D,T	Frequency adjustment	3.5.1
D	Crystal units	3.5.2
D,T,P	Synthesizer preset	3.5.3
D,T	Starting	3.5.4
D	Long term frequency drift	3.5.6
D	Crystal oven	3.5.7
D,T,P	Frequency synthesizer timing	3.5.8
D,T	Frequency accuracy and stability	3.6
D,T	Maximum allowable frequency deviation	3.6.1
D,T	Effect of detuning and retuning	3.6.2
D,T	Local oscillator coupled output	3.7
D,T	Oscillator interaction	3.8
D,T	Operational stability	3.9
D,T	Receiver sensitivity	3.10
D,T	RF gain control	3.11
D,T	Selectivity	3.12
D,T	Pass band characteristics	3.12.1
D,T	Undesired RF responses	3.13

Class	Test	Paragraph of this Specification (Part III)
D,T	Blanking filter	3.13.2
D,T	Commutation filter	3.13.2
D,T,P	Squelch	3.18
D,T,P	Muting	3.18.1
D,T,P	Squelch switch	3.18.2
D,T,P	Bearing	3.18.3
D,T	Audio outputs	3.22
D,T,P	Headset outputs	3.22.1
D,T,P	Interunit output	3.22.2
D,T	Two way voice intercom	3.23
D,T,P	Protective devices	3.27
D,T	Covers	3.28
D,T	Accessibility	3.28.1
D	Handles	3.29
D,T,P	Test points	3.30
D,T,P	Test point remoting capability	3.30.1
D,T	Power sources	3.31
D,T	Power supply	3.31.1
D,T,P	Indicator lights	3.32
D,T,P	Special tools	3.33
D,T,P	Front panel specification	3.34.1
D,T,P	Rear panel specification	3.34.2
D,T	Bearing process unit	3.35 thru 3.35.4

4.8 Test - service conditions. - The tests listed in the following tabulation shall be performed with all power transformer taps set at 120 volts while subjecting the equipment to the test procedures described in 1-3.3.1, 1-3.3.1.1, 1-4.12 of FAA-G-2100/1, and the service conditions as specified in 3.4.2 of Part I hereof. Refer also to 3.4.2 of Part I hereof. The Squelch Switch shall be on during the test.

Class	Test	Paragraph of this Specification (Part III)
D	Equipment	3.2.1
D	Chassis	3.2.2
D,T	Receiver	3.3.1
D	Frequency conversion	3.3.1.1
D,T	Tuning	3.3.1.2
D	Leakage	3.3.1.3
D	Antenna circuit	3.4
D	Artifical antenna	3.4.1
D	Protective devices	3.4.2
D,T	Frequency synthesizer	3.5
D	Frequency adjustment	3.5.1
D,	Crystal units	3.5.2
D	Synthesizer preset	3.5.3
D	Starting	3.5.4
D	Long term frequency drift	3.5.6

Class	Test	Paragraph of this Specification (Part III)
D	Crystal oven	3.5.7
D	Frequency synthesizer timing	3.5.8
D	Frequency accuracy and stability	3.6
D	Maximum allowable frequency deviation	3.6.1
D	Effect of detuning and retuning	3.6.2
D	Local oscillator coupled output	3.7
D	Oscillator interaction	3.8
D	Operation stability	3.9
D	Receiver sensitivity	3.10
D	RF-gain control	3.11
D	Selectivity	3.12
D	Pass band characteristics	3.12.1
D	Undesired RF responses	3.13
D	Blanking filter	3.13.2
D	Commutation filter	3.13.3
D	Squelch	3.18
D	Muting	3.18.1
D	Squelch switch	3.18.2
D	Bearing	3.18.3
D	Audio outputs	3.22
D	Headset outputs	3.22.1
D	Interunit output	3.22.2
D	Two way voice intercom	3.23
D	Protective devices	3.27
D	Covers	3.28
D	Accessibility	3.28.1
D	Handles	3.29
D	Test points	3.30
D	Test point remoting capability	3.30.1
D	Power sources	3.31
D	Power supply	3.31.1
D	Indicator lights	3.32
D	Special tools	3.33
D	Front panel specification	3.34.1
D	Rear panel specification	3.34.2
D	Bearing process unit	3.35 thru 3.35.4

5. PREPARATION FOR DELIVERY. - See Section 5 of Part I, hereof.

6. NOTES. - See Section 6 of Part I, hereof.

PART IV

BEARING DISPLAY AND CONTROL UNIT

1. SCOPE

1.1 Scope. - This unit consists of a 3-digit numeric display bearing indicator, manual and automatic 720 channel frequency selection capability, controls, switches, indicator for complete remote operation of the DF and an appropriate interface to a 4-wire voice grade circuit (FAA local circuit or type 3002 voice-band width data channel without conditioning).

2. APPLICABLE SPECIFICATIONS AND DRAWINGS

2.1 - See Section 2, Part I, hereof.

3. REQUIREMENTS

3.1 - See Section 3, Part I, hereof.

3.2 Packaging and construction. -

3.2.1 Equipment mounting. - The bearing display and control unit and associated power supplies shall be designed to mount in a Type I, II and III cabinet time rack in accordance with specification FAA-E-163. The rack is not to be furnished by the contractor of this equipment.

3.2.2 Chassis. - Chassis must be capable of mounting in a standard 19" rack or sloped surface console. The chassis shall be equipped with full suspension roller bearing pull-out forward and rotated to the +45, +90, and +135 degree positions for maximum access for servicing. Latching stops shall be provided for all positions. Installation of the equipment and suspension mechanism shall not require modification of the cabinet rack or console. Means shall be provided to protect and guide the equipment cable connections so that the equipment units may be freely adjusted to all positions allowed by the suspension mechanism without any interference between the cables and other equipment mounted immediately above and below in the cabinet rack or console.

3.3 Bearing display and control unit. - Shall be a console mounted unit with the capability to be mounted in a standard 19" rack or sloped surface console. The maximum depth of the remote unit shall be 20". The front panel shall contain the electronic bearing display indicators, numeric key pad for frequency selection, and any other switches or controls required for complete control of the DF from the operator position. The console/rack is not to be furnished by the contractor.

3.3.1 Covers. - The unit shall be fully enclosed with easily removable metal dust covers. The covers shall be constructed of sheet metal and be provided with a minimum number of openings to permit adequate ventilation with the equipment operating.

3.3.2 Accessibility. - The major components of the bearing display and control unit and all necessary test points and adjustments or alignment controls other than those on the front panel shall become readily available with the covers removed.

3.3.3 Handles. - Two handles shall be provided and located on the front panel for handling the unit during insertion and removal from its mounting place.

3.3.4 Test points. - Test points necessary to confirm proper operation of the bearing display and control unit and necessary in the location of faults in major modules shall be available. Test points to be chosen by the vendor with Government approval required. Test points shall be readily identified and cross-referenced in the instruction book which also shall contain reference to necessary waveforms, voltage, current, or resistance readings that may be appropriate for the individual test points.

3.3.4.1 Test point remoting capability - All test points shall be wired to a connector located on the rear of the equipment. The connector shall provide the capability for remote equipment monitoring to accommodate future automation.

3.3.5 Power sources. - The receiver shall operate from power sources specified in paragraph 3.4.1, Part I of this specification.

3.3.5.1 Power supply. - The power supply shall be designed as an integral part of the unit with adequate measures taken to insure against the generation of the RF and AF interference that would be objectionable in communication receivers located adjacently. An AC power cord shall be provided in accordance with paragraph 3.25 of Part I.

3.3.6 Indicator lights. - Indicator lights and their associated assemblies shall be in accordance with FAA-G-2100/1, paragraph 1-3.16.5.

3.3.7 Special tools. - The contractor shall supply, with each bearing display and control unit any special tools required to maintain this equipment, including aligning and adjusting tools which shall be mounted in suitable clips on the chassis.

3.4 Front and rear panel controls and indicators.

3.4.1 Front panel specification. - Channel selection, control, and bearing display shall be located on the front panel of a chassis in accordance with paragraph 3.3, Part IV. Front panel controls and indicators shall consist of the following:

Control or Indicator	Description	Function
Power On/Off control	Two-position toggle	When set to ON, power is applied to the unit; when set to OFF, unit is inoperable and consumes no power.
Power ON/OFF Indicator	Lamp, green	Illuminates when the power switch is turned ON.
Fuse	Fuseholder	Active AC line fuse
Spare	Fuseholder	Spare AC line fuse
Local Indicator	Lamp, white	When illuminated, indicate DF system is in Receiver and Bearing Process Unit LOCAL control.
System Alarm	Lamp, red	When illuminated, indicate failure mode including parity error, control line failure, and interunit failure.
Receiver-Frequency MHz Display	Six-Digit Display	Displays the frequency that is selected. Activates only after synthesizer is locked up. (See 3.5.8 of Part III.)
Frequency MHz Select	Numeric keypad	Selects any of 10 preset channel frequencies by pressing a single numeric key and the enter key in sequence. Selects any frequency by pressing numeric keys in sequence and then pressing the enter key. Selection is enabled during remote control only.

Control or Indicator	Description	Function
Bearing Clear Switch	Momentary pushbutton	Clears the bearing display until another bearing is processed and displayed; during remote control.
Bearing Display	Three-digit display surrounded with electronic compass rose.	Displays the processed bearing angle in degrees from 000^{o} to 359^{o} in one degree increments.
QDM or QDR Select	Two-position switch with spring return to QDR normal position	When set to QDM, the dis-bearing angle is referenced from the source (aircraft) to the DF antenna; when set to QDR the displayed bearing angle is referenced from the DF antenna to the source; during remote control.
QDR Indicator	Lamp, amber	Illuminates when bearing reference is QDR.
Squelch ON/OFF Control Switch	Two-position switch with spring return to ON normal position	When set to ON the receiver squelch operate normally; when set to OFF, the squelch is disabled; during remote control.
Squelch Indicator	Lamp, blue	Illuminates when the receiver audio is enabled (not squelched).
Headset output	Headset jack	Provides an audio output
Headset Output Level Control	Potentiometer	Adjust audio level at the headset output.
Dimmer control	Potentiometer	Controls the brightness of all light emitting devices on the front panel.
System Test Control	Momentary Pushbutton	Initiates a self-test routine that checks power supplies and verifies receiver - processor operations; during remote control.

Control or Indicator	Description	Function
Lamp Test	Momentary Pushbutton	Illuminates all lamps to verify operation.
Fault Meter Control	Meter and Rotary Switch	Provides indications of power supply voltages and key performance parameters.
Overhead Pass Indicator	Lamp, yellow	Illuminates when aircraft passing over the DF antenna transmits on the selected frequency and the DF is unable to display a useable bearing.

3.4.2 Rear panel specification. - The AC power plug, equipment interconnection plug, two way voice intercommunication plug and remote monitoring plug shall be located on the rear of the bearing display and control unit (see Part I, paragraph 3.28).

3.5 Voice capability. - The bearing display and control unit shall provide the capability of monitoring voice reception through a headset output jack. Voice audio shall be free of commutation noise or other DF generated pulse signals.

3.5.1 Headset output. A standard headset jack shall be front panel mounted to provide capability to monitor an audio output. A front panel control shall be provided to adjust the output level from -30 dBM to +10 dBM into a 600 ohm load.

3.6 Multiple signal capability. - The bearing display indicator shall display three dashes during periods of multiple signal reception by the receiver and bearing process unit in accordance with paragraph 3.14, Part I. Voice shall continue when multiple signals are detected.

3.7 Bearing display. - The bearing display indicator shall be a lighted three digit numeric display large enough to be read with ease from a distance of six feet. The three digit display shall be surrounded by an electronic compass rose (a ring of LEDs). The indicator shall display the processed bearing angle in degrees from 000° to 359° in one degree increments. Each LED shall illuminate individually to represent the relative azimuth of the bearing indicated on the three digit numeric display.

3.8 Two way voice intercom. - Provision shall be made for rear panel connection of an external two way voice intercom unit. The intercom unit is not to be furnished as part of this specification. The intercom will be used for interfacility voice communication between the antenna/receiver and bearing process unit site and the bearing display and control unit site. Provision shall be made for simultaneous transmission of two way voice communication and all other interunit signals in accordance with paragraph 3.26.1 of Part I.

4. QUALITY ASSURANCE PROVISIONS

4.1 General. - See Section 4.1 of Part I, hereof.

4.2 Line frequency. - See Section 4.2 of Part I, hereof.

4.3 Classification of tests. - See Section 4.3 of Part I, hereof.

4.4 Design qualification tests. - See Section 4.4 of Part I, hereof.

4.5 Type tests. - See Section 4.5 of Part I, hereof.

4.6 Production tests. - See Section 4.6 of Part I, hereof.

4.7 Test - normal test conditions. - The following tests shall be performed under normal test conditions (See 3.4.1, Part I hereof). The applicable nominal AC power source voltage and the corresponding tap setting shall be 120 volts.

Class	Test	Paragraph of this Specification (Part IV)
D,T	Equipment mounting	3.2.1
D,T	Chassis	3.2.2
D,T,P	Bearing display and control unit	3.3
D,T	Covers	3.3.1
D,T	Accessibility	3.3.2
D	Handles	3.3.3
D,T,P	Test points	3.3.4
D,T,P	Test point remoting capability	3.3.4.1
D,T	Power sources	3.3.5
D,T	Power supply	3.3.5.1
D,T,P	Indicator lights	3.3.6
D,T,P	Special tools	3.3.7
D,T,P	Front panel specifications	3.4.1
D,T,P	Rear panel specifications	3.4.2
D,T	Voice capability	3.5
D,T,P	Headset output	3.5.1
D,T	Multiple signal capability	3.6
D,T,P	Bearing display	3.7
D,T	Two way voice intercom	3.8

4.8 Tests - service conditions. - The test listed in the following tabulation shall be performed with all power transformer taps set at 120 volts while subjecting the equipment to the test procedure described in 1-3.3.1, 1-3.3.1.1, 1-4.12 of FAA-G-2100/1 and the service conditions as specified in paragraph 3.4.2 of Part I hereof.

Class	Test	Paragraph of this Specification (Part IV)
D	Equipment mounting	3.2.1
D	Chassis	3.2.2
D	Bearing display and control unit	3.3
D	Covers	3.3.1
D	Accessibility	3.3.2
D	Handles	3.3.3
D	Test points	3.3.4
D	Test point remoting capability	3.3.4.1
D	Power sources	3.3.5
D	Power supply	3.3.5.1
D	Indicator lights	3.3.6
D	Special tools	3.3.7
D	Front panel specifications	3.4.1
D	Rear panel specifications	3.4.2
D	Voice capability	3.5
D	Headset output	3.5.1
D	Multiple signal capability	3.6
D	Bearing display	3.7
D	Two way voice intercom	3.8

5. PREPARATION FOR DELIVERY

5.1 - See Section 5 of Part I, hereof.

6. NOTES

6.1 - See Section 6 of Part I, hereof.

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